5

Scientific realism

However we resolve the debate about the nature of the scientific method, most parties seem to accept that science is usually the best guide we have to the future behaviour of things we can observe, for example comets, bridges, power plants and rainforests. Our scientific knowledge is fallible, partial and approximate, but usually it is the most reliable means we have for predicting phenomena in the world around us. However, science is often taken as telling us much more than this. The natural sciences seem to tell us about the ultimate nature of things and are often thought to have replaced metaphysics as the study of the fundamental structure of reality. Modern science presents us with what seems to be a detailed and unified picture of reality that describes the composition of things and the laws that they obey, from the internal structure of atoms to the life cycles of stars. Contemporary genetics and brain science even seem to offer the prospect of a physical science of human beings and their behaviour. Many of the entities postulated by modern science, such as genes, viruses, atoms, black holes, and most forms of electromagnetic radiation, are unobservable (at least with the unaided senses). So, whatever the scientific method is and however scientific knowledge is justified, we can ask whether we ought to believe what science tells us about reality beyond the appearances of things. Roughly speaking, scientific realism is the view that we should believe in the unobservable objects postulated by our best scientific theories.

Of course, many of those who defend scientific realism also defend the rationality of scientific theory change against sceptics and relativists. However, some ancient and modern critics of scientific realism

have not questioned the success or even the progress of scientific inquiry. Many antirealists about scientific knowledge in the history of philosophy are happy to agree with realists that science is the paradigm of rational inquiry, and that it has produced a cumulative growth of empirical knowledge. However, antirealists of various kinds place limits on the extent and nature of scientific knowledge. Hence, the issue of scientific realism is more subtle than many of the polarised debates of science wars, and it is important not to confuse the former with questions about the rationality of science.

The disputes about scientific realism are closely related to those about other kinds of realism in philosophy, some of which will be explained in this chapter, but the reader – especially one with a good deal of scientific knowledge – may already be feeling impatient. Isn't it just obvious that plenty of unobservables described by scientific theories exist; after all, don't scientists manipulate things like atoms and invisible radiation when they design microchips and mobile phone networks? In fact, is it really correct to describe atoms as unobservable? After all, don't we now see photographs of crystal lattices made with microscopes that use electrons instead of light to generate images? Is there really any room for reasonable doubt that atoms exist when so many different parts of science describe how they behave and give rise to everything from the characteristic glow of the gas in a neon light on a billboard, to the way that haemoglobin in red blood cells absorbs oxygen in our lungs?

Even if we decide that atoms are now observable, the issue of principle returns when we ask about the existence of the entities that supposedly make up atoms, and so on. Furthermore, scientists of the past claimed to be manipulating and observing theoretical entities that no longer feature in our best scientific theories, so why should we have such faith that we have it right this time? These and other arguments for and against scientific realism will be the subject of the chapters that follow. First, in this chapter, I will explain the background of the contemporary debate, and the different components of scientific realism. We begin with the distinction between appearance and reality.

5.1 Appearance and reality

The physicist Arthur Eddington makes the distinction between appearance and reality conspicuous with his famous discussion of two tables:

> One of them has been familiar to me from earliest years. It is a commonplace object of that environment which I call the world. How shall I describe it? It has extension; it is comparatively permanent; it is coloured; above all it is substantial.
>
> (Eddington 1928: ix)

> Table No. 2 is my scientific table. It is a more recent acquaintance and I do not feel so familiar with it. It does not belong to the world previously mentioned – that world which spontaneously appears around me when I open my eyes, though how much of it is objective and much subjective I do not here consider. It is part of a world which in more devious ways has forced itself on my attention. My scientific table is mostly emptiness. Sparsely scattered in that emptiness are numerous electric charges rushing about with great speed; but their combined bulk amounts to less than a billionth of the bulk of the table itself.
>
> (Eddington 1928: x)

Eddington distinguishes between the world of common sense and the world as it is described by science. The scientific description suggests that common-sense reality is an illusion, or at least that we certainly don't perceive the world to be anything like the way it is in certain respects. In the twentieth century, physics became increasingly abstract and removed from common sense. In particular, relativity theory and quantum mechanics made the scientific understanding of space and time and the nature of matter, respectively, remote from everyday experience. The description of the ultimate constituents of the table given by contemporary physics depends upon a lot of very difficult mathematics; it is not possible to understand the multi-dimensional worlds of quantum fields, 'superstrings' and the like without it. Hence, although there is an everyday counterpart to the scientific table, there are no everyday counterparts to the 'electric charges' that compose it. So do both tables really exist? If so what is

the relationship between them? To understand the philosophical issues raised by Eddington's two tables we must again return to the scientific revolution, and to a philosophical distinction between two types of property that was employed by many of the great thinkers who pioneered the modern scientific outlook, namely that between *primary* and *secondary* properties (or qualities).

As we saw in Chapter 1, the scientific revolution was characterised by various features, including:

(1) A renewed emphasis on experiments and the use of novel technologies such as the telescope, the microscope and the air pump to 'torture nature for her secrets'.
(2) The abandonment of much of the qualitative description of nature given in Aristotelian science (for example, the effects of opium were explained by saying opium has a 'dormative virtue'), in favour of quantitative descriptions of natural properties (for example, the idea of an object having a quantity of matter – its mass – rather than a certain virtue of heaviness).
(3) The abandonment of the search for final causes (teleology) characteristic of Aristotelian science and a concentration on immediate (efficient) material causes.
(4) Science was increasingly regarded not as *a priori* knowledge of necessary truths as in Aristotelian *scientia*, but as empirical (*a posteriori*) inquiry.

The guiding image employed by many writers of the time was the depiction of nature as a giant clockwork machine. The point about a clockwork machine is that the parts all work together in harmony, not because they are co-ordinated by mysterious natural motions or final causes, but because each of them communicates its motion with the part adjacent to it by contact. (A cog here turns a cog there which turns the next one and so on.) People began to envisage the possibility of explaining the behaviour of things in terms of motions of the particles that compose them, rather than in terms of essences and 'occult forces'. Mechanics, in the hands of Galileo, Descartes and Newton in particular, became a mathematically precise science of matter in motion, and what happens as a result of collisions between bits of matter. (All of them adopted a principle of inertia, which states that a body continues in its state of motion unless a

force acts to change it, so only changes in motion require an explanation.)

Newton's theory of gravitation was problematic because Newton offered no explanation for how the force of gravity was transmitted between bodies separated in space. It seemed that gravity was an example of the kind of 'action at a distance', which mechanist philosophers were trying to avoid. However, the law of gravitation Newton proposed was at least a precise mathematical one and Newtonian mechanics became incredibly empirically successful. The mysterious nature of gravitational attraction was not enough to stop Newton's theory being adopted by increasing numbers of natural philosophers, and eventually it was accepted by all the scientific establishments. In any case, even Newton hoped that mechanical explanation of gravity would one day be available, and the goal of explaining all manner of natural phenomena in mechanical terms was widely shared. *Materialism*, the idea that there is only one substance, namely matter, and that there is no immaterial soul beyond the body because the human mind is no more than the product of matter in motion, was increasingly popular. Meanwhile, there began a scientific research programme to find out how much of human physiology and behaviour could be explained using physics and chemistry. (An important early success was the understanding of the heart as a pump and the discovery of the circulation of the blood due to William Harvey (1578–1657), who had quantitatively analysed the flow of blood.)

To return to the clock analogy, which Locke used to illustrate the goal of natural philosophy as he saw it: the hands seem to move in a co-ordinated way and the chimes ring out the hours, half hours and so on as appropriate; this corresponds to the appearances of things, the observable properties of, say, a piece of gold. However, the clock has inner workings and this mechanism produces the outer appearance of the clock; similarly, the gold has an inner structure that gives rise to its appearance. The goal of natural philosophy is to understand the inner mechanisms responsible for what we observe.

The success of science since Locke's time seems to depend upon the ingenious invention of devices of all kinds to improve upon the accuracy of the senses, say by using scales to measure mass, and also to measure a variety of properties, such as electrical potential, which

are not apparent to the senses at all. Indeed, the growth of many sciences depends upon reducing reliance on the specific character of sense experience as a way of gathering data. This can be seen in the history of chemistry, as the categorisation of substances according to colour, smell, and so on, has been gradually replaced in favour of measures such as refractive index, atomic number and ionisation potentials. This offers to fulfil the aspiration for science to be objective, if the subjectivity of human perception can be banished from observation in science, in favour of thermometers, light meters, and eventually even automated recording devices. (Of course modern scientists often use computers to process further the data that their machines gather, to speed up and cross-check calculations, and to generate directly numerical outputs, graphs, maps and so on.)

To put it simply, primary properties are those properties that things not only appear to have, but which they also have in reality. Secondary properties are those which things appear to have but which they don't possess in themselves, only in the mind of the observer. There are many arguments to establish a distinction between the properties things really have and those they only appear to have. There are also many arguments to show that we have no principled way of adjudicating rival claims about what properties things possess. Most appeal to the relativity and variability of how things seem to different people at different times. If the shape and colour of the table are different depending on the lighting and the position of the observer, who can say what shape and colour the table really is? (Many of these arguments were formulated and compiled by the ancient Greek sceptics.) Berkeley gives a famous example of three pans of water, one very cold, one very hot and one at room temperature. If you put your hand in the hot water and then in the room temperature one, the latter feels cold, whereas if you put your hand in the cold one first and then the room temperature one, it feels warm. Hence, the warmth that you feel does not directly correspond to any property of the water. Similarly, it seems that modern science tells us that colour vision is the product of a complex process of light refraction, and that the colours we see do not correspond to simple properties of objects.

The distinction between primary and secondary properties goes back at least to the ancient Greek atomists, who thought that things only *seem* to be, for example, sweet to the taste, cold to the touch, or

pleasing on the eye, but that these are not the properties of things as they really are. Atomists go on to say that the properties things really have are the properties of the atoms that make them up, plus complex structural properties due to the arrangement of the atoms. Similarly, in the seventeenth century, many advocates of the new mechanical philosophy of the day, such as Locke, Robert Boyle (1627–1692), Pierre Gassendi (1592–1655), and Newton argued that the primary properties of things are those possessed by the corpuscles or particles that compose an everyday object like a table, whereas the secondary properties are caused by the way the corpuscles are organised, but are not really properties of those corpuscles themselves. So, for example, the corpuscles that make up my table are not brown, nor are the corpuscles making up honey sweet. The colour of a table or the taste of a food are not primary but secondary qualities of those things. On the other hand, the corpuscularians of the seventeenth century argued, corpuscles do all have a shape, a position and are either moving or stationary, so these are some of their primary properties. Among these and other 'mechanical philosophers', there was a general consensus that science should focus on the primary properties of things in order to explain how things appear to us.

Locke distinguished between the *real* and *nominal* essences of things. The nominal essence of gold is just the abstract and general idea that we have of it; so it is yellow, heavy, malleable, dissolves in certain acids, is shiny, and so on. The nominal essence is based on the appearance of gold to us, but of course there are other things that appear like gold, such as iron pyrites or 'fool's gold', and sometimes real gold may not conform to the nominal essence, for example, if it is molten. Hence, what distinguishes real gold from fool's gold is that the former has the real essence of gold and the latter does not. The real essence of something is whatever its underlying nature is. Locke saw no evidence that the scientists of his day could be said to 'know' the real essences of things. However, he did think that there was the realistic prospect of 'probable opinion' about them, and he thought that the real essences of things would turn out to be their microstructural constitution – in other words, the forms and configurations of corpuscles. Modern science seems to have fulfilled this ambition in some cases. For example, the real essence of gold seems to be that it has atomic nuclei consisting of 79 protons.

Does a piece of gold have a colour in the dark? If we chop up the gold into very tiny pieces they remain gold, but they no longer look like gold. On the other hand, Locke thinks the bits of gold retain their mass, their impenetrability and spatial extension whatever we do to them and whether we are looking at them or not. Hence, Locke argues that the colour that we perceive when we look at gold does not resemble anything in the object before us. The gold only has the power to bring about characteristic experiences of seeing gold under certain conditions. He concludes the primary properties exist in objects whether we perceive them or not, but secondary properties do not exist unperceived. So, although in a sense the gold does possess the property of yellowness, this is really a *power* or *disposition* to produce a certain type of sensation in us and there is nothing resembling our experience of yellow in the corpuscles themselves. This makes secondary properties such as colours similar to a property like the fragility of a piece of glass, which is a disposition to break under certain conditions, which glass has in virtue of its micro-structural constitution. Glass is fragile even if it is never broken; similarly the table is brown even if nobody looks at it, because it has a stable disposition to appear as it does to a human observer.

Some of the ideas we have of the properties of objects, for example length or volume, resemble the property in the object that causes the idea. These are primary properties. But the corpuscles making up, say, a piece of gold, are not themselves yellow, malleable, shiny, and smooth. Our sensory experience of these properties is produced by the nature, arrangement and state of motion of the corpuscles that make up gold. The idea of, say, yellow, which we get from perception does not resemble the properties of the corpuscles of gold that cause it. Hence, to be more accurate, primary properties are those that resemble our perceptions of them, whereas secondary properties do not. Note that two objects with all the same primary properties must have all the same secondary properties too. This does not work the other way round, because it is possible for things having very different primary properties to give rise to the same secondary property; after all lots of very different substances all interact with the light that hits them to produce the experience of seeing yellow when the light they reflect hits our eyes. (Secondary properties are said to *supervene* on primary properties because of this kind of one-way dependence.)

Primary quantities are supposed to be measurable and quantifiable properties, such as volume, mass or velocity, or at least to be calculated from other quantities, such as density, which is mass divided by volume. In the seventeenth century, the new quantitative way of describing the world was based on the use of geometry to represent the motion of matter in space. Nearly all of the properties of things that were thought to be primary during the Scientific Revolution, for example extension, motion and size, can be represented geometrically. Calculus enabled Newton to calculate velocity and acceleration geometrically too. Descartes also believed in the distinction between primary and secondary properties. However, he did not believe in atoms, but rather that space is completely full of matter, and so he thought the properties of impenetrability and mass were unnecessary. He also thought all the primary properties were geometrical, but the non-geometrical primary property of mass was eventually widely accepted. Since then, science had relied increasingly upon properties that can be represented numerically, and related by laws and equations that are mathematically complex.

So Eddington's scientific table is the bearer of the primary properties that are measured and described by scientific theories, whereas the commonplace table also bears the secondary properties of our everyday experience. The secondary properties of the commonplace table are reducible to the primary properties of the scientific table in the sense that they are powers or dispositions to produce, in the right conditions, certain effects in us. For example, the brownness of the table is a disposition to produce a characteristic kind of sensory experience in us under normal lighting conditions. Once we adopt the primary/secondary property distinction we need to explain the relationship between our experience of things and their primary properties, and also how we can *know* about the primary properties of things at all. If we concede that many of our ideas of the properties things have do not correspond to their real properties, how do we know that our ideas of the supposed primary properties of things correspond to how those things are? Furthermore, how do we even know there are any things beyond our experiences?

5.2 The metaphysics of the external world

The debate about scientific realism is closely related to the general issue of our knowledge of the external world in the history of philosophy. **Metaphysical realism** is the view that our ordinary language refers to, and sometimes says true things about, a *mind independent* world; Eddington's commonsense table exists and is heavy, brown, solid and so on. Mind-independence means that even if there were suddenly no human beings or other creatures to perceive tables, those that exist would still do so. In other words, the table in my room is here whether or not anyone looks at it. (Philosophers often talk about the 'external world', as opposed to the internal world of the mind.) Scientific realism involves a metaphysical commitment of a similar nature to Eddington's table No. 2; electrons, genes and other unobservables are part of a mind-independent world.

Many people become frustrated with philosophy when they learn that philosophers worry about such issues. Even if it seems legitimate to question the existence of electrons, how can anyone seriously doubt the existence of everyday objects such as tables, trees and other people? However, the real philosophical problem is not to find out if everyday objects exist, or even if we know that they do, but rather to explain *how* we can know that they exist and what their nature is. The problem of metaphysical realism arises because of the difficulty in making knowledge of the external world compatible with seemingly plausible empiricist theories about knowledge and perception. As with the problem of induction, when a philosophical argument that seems sound leads to a conclusion that most people cannot accept (for example that induction is irrational, or that we can't know there are tables in the world), perhaps the challenge for philosophers is not to persuade people of these absurd conclusions, but to identify where the flaw is in the argument.

5.2.1 Realism and ideaism

It seems that our knowledge of the world comes from our senses. It is only because I perceive the table in front of me by seeing and touching

it that I know it is there. The simplest view to take about the world and our perception of it is called **direct realism**.

> **Direct realism**: there are external objects that exist independently of our minds and which we directly perceive with the senses.

However, it was argued above that many of the properties that the table seems to have are, in fact, artefacts of the way our sense organs and perception works. Many philosophers have taken the arguments we discussed in the section, among others, to show that we do not directly perceive objects in the world around us, but rather the representations of those things produced in the mind. For example, under a red light, and seen from a distance, the table in front of me looks red and rectangular, even though it is in fact brown and square. If what I see is an image of the table in my mind's eye, as it were, this explains how it is that the table can look different to different observers and under different lighting conditions and so on. Another famous argument to show that the direct objects of perception are not external objects is the argument from illusion: take the case of a straight stick which appears bent when standing in a transparent container of water; the stick itself is not bent, yet the stick we see is bent, therefore what we see is not the real stick, but an image or idea of it. These and other arguments that appeal to cases of perceptual error, dreams and hallucinations may be taken to show that the senses do not give us direct knowledge of objects.

A couple of further reasons for abandoning direct realism derive from our scientific understanding of how the senses work. So, for example, in the case of sight, we know that light is either emitted or reflected by the things that we see, that it passes through space, and then impacts upon the eyeball where an image is focused on the retina. The light hitting the retina activates certain cells that send electrical impulses to the visual cortex of the brain. This is only the beginning of the story but already there are two important features to note; first, there is a chain of causes between an object and a person that sees it, and secondly, time elapses between the object emitting the light and a person seeing something. This is already enough to suggest that perception cannot be direct, because we see things as they were recently not as they are at the time we perceive them, and because perception is mediated by the image produced on the retina.

In Chapter 4, I discussed the idea of theory-laden observation. Recent empirical work seems to suggest that what we see is, at least in part, constructed by our brains, rather than being simply an image transmitted from the retina. So, for example, it has been found that if someone is given a pair of spectacles with lenses that turn everything upside down, then at first they will be quite unable to see properly. However, after a while, their brain will adapt and they will start seeing everything the right way up again. Then if the spectacles are later removed, the world will look upside down again until the brain readjusts.

The doctrine that the immediate or direct objects of perception are ideas in the mind, rather than objects in the external world was called **ideaism** by Alan Musgrave (1993) (not to be confused with **idealism**, of which more later).

> **Ideaism**: We do not directly perceive external objects but rather our minds' own ideas or representations of the world.

This was the theory held by the British empiricists, Locke, Berkeley and Hume, who have done so much to influence philosophy of science. According to these thinkers, the mind is not directly aware of objects in the world at all, but rather of what they called 'ideas' and 'impressions': Locke says the mind 'hath no other immediate object but its own ideas' (Locke 1964: Book IV, i, I); Berkeley says 'the objects of human knowledge are either ideas actually imprinted on the senses, or else such as are perceived by attending to the passions and operations of the mind' (Berkely 1975: Part I, I); and Hume says '[a]ll the perceptions of the human mind resolve themselves into impressions and ideas' (Hume 1978: I,i,I). A twentieth century version of ideaism was maintained by Alfred Ayer (1910–1989) who said, 'one can directly experience only what is private to oneself' (Ayer 1940: 136). (These supposed immediate objects of experience are what many twentieth century philosophers used to call 'sense-data'; they are also sometimes called 'the given'.)

All of the British empiricists thought that there were basically two types of mental objects or ideas, namely those that are produced by the senses and the emotions, and those that are copies or faint images of the former. It is best to take Hume's terminology because he distinguishes between 'impressions' and 'ideas', to make this distinction

clear; hence, the impression of red is what is forced on the mind by the senses, whereas the idea of red is the image of that impression that one can bring before the mind at will. Similarly, the impression of anger is the feeling that one has when one is angry, whereas the idea of anger is the faint copy of that impression which is before the mind when one thinks about anger.

Ideaism contradicts direct realism, but not the part of the latter that says that there are external objects. Ideaism is a thesis about the nature of perception, not a metaphysical thesis about what exists. Hence, ideaism is compatible with metaphysical realism. If ideaism is right and we perceive only our own impressions and ideas, then what is the relationship between objects in the world and the impressions I have of them? The obvious answer is that my impressions are *caused* by external objects. The primary properties of those objects resemble the impressions they produce in us, but the impressions of colours, tastes and so on are caused by configurations of the primary properties that do not resemble them. Impressions are the direct objects of our experience, and they stand between us and the external world of objects and their genuine properties. Such a view is called representative, indirect or **causal realism** and is to be contrasted with direct realism.

> **Causal realism**: there are external objects that exist independently of our minds and which cause our *indirect* perception of them via the senses.

Causal realism was advocated by Locke who combined it with the distinction between primary and secondary properties and corpuscularianism.

However, once we adopt causal realism instead of direct realism, we have opened up a gap between the world as we perceive it and the world as it is. How then do we know that our perception of the world is at all faithful to the way the world is? Sceptical arguments known since ancient times make the senses seem a dubious source of knowledge. We have seen how the philosophers of the scientific revolution accepted the idea that reality might be very different from how things appear to the senses. The distinction between primary and secondary properties is intended to separate those aspects of our sensory experience of the world that we can trust as guides to the real properties of

things, from those we cannot. However, assuming that some properties are secondary, and do not resemble the ideas they cause in us, how do we know there are *any* primary properties resembling our ideas of them? For Locke, it is down to the practice of science to give us probable opinion about such things. In his day, natural philosophers thought it unnecessary to imagine that anything like yellow as we experience it belongs to objects in the world, in order to explain our experience. However, they did find it necessary to impute primary properties of length, breadth, motion and so on to explain our experience. For them, primary properties are the properties of matter, most fundamentally the property of extension (occupying a volume of space).

5.2.2 Idealism

Berkeley famously attacked the distinction between primary and secondary properties. The interesting thing about Berkeley's arguments is that, although his conclusions are radically opposed to those of Locke, he bases his arguments on doctrines that Locke seems to accept, such as empiricism about knowledge and meaning, and ideaism. Berkeley was opposed to causal realism, but also to any other form of metaphysical realism, and he denied the existence of matter. This is enough for many to discount Berkeley as someone who contradicts our common sense. However, it is important to be clear that he does not claim that tables, chairs and other 'material objects' don't exist, but that these and other such objects are not mind-independent, and are not made up of corpuscles that possess primary properties.

His first argument is that the doctrine of materialism is meaningless. Here, materialism is not a view about the reducibility of the mental to the physical, but is just the doctrine that matter exists. 'Matter' means something quite specific, namely that which possesses the primary qualities of extension in space, motion, number and so on, and which exists independently of the mind. Berkeley's argument is as follows:

(1) We experience only 'ideas' and not material objects (ideaism).
(2) All our ideas come from experience (concept empiricism).

(3) The words 'material object' cannot stand for any idea and are therefore meaningless (immaterialism).

Like many empiricists after him, Locke argued that the mind at birth is like a blank sheet of paper which is then written on by experience, and was strongly opposed to the rationalist thesis that we have ideas, or concepts prior to sensory experience of the world. Hence, Locke seems to believe both (1) and (2). But if we cannot experience matter directly, and if all our ideas are derived from experience, then we ought not to be able to have an idea of matter. Matter is defined as that which lies beyond all our experience, so how can experience give us any idea of it? The reader may be tempted to abandon ideaism at this juncture, but as we have seen, the arguments for ideaism are quite strong. However, perhaps a more promising response is to qualify (2). After all, our ideas may all come from experience, but it may still be possible for us to combine them to create the idea of matter, say by combining the idea of extension in space with the idea of a cause. Berkeley has much more to say, for example, about why matter cannot cause anything, but we will leave this argument for now and turn to his attack on the primary/secondary property distinction.

Berkeley denied the distinction between primary and secondary properties on various grounds, which are summarised below:

(a) The primary/secondary distinction is supposed to correspond to that between the *objective* and the *subjective* but, Berkeley argues, nobody has adequately characterised the latter distinction, and so it cannot be invoked to explain the former one.
(b) The primary properties are supposed to be those that are stable, while the secondary properties are those that are perceptually relative; but we cannot know that the primary properties are really stable, only that they are stable relative to our perceptual make-up. Indeed, the size of things is dependent on some scale being adopted – motion, as Galileo discovered, is relative to some frame of reference and so on. Hence, Berkeley argues, primary properties are as relative and variable as secondary ones.
(c) The primary properties of a body are those which it is supposed to have just in virtue of it being a material object, but then our experience of bodies is that they always have a colour as well as a shape and so on. Berkeley denies that one can imagine a material

> body that has no colour at all, hence he argues that there are no grounds for detaching colours and so on from material objects but not shape, size and motion as well.

What can we say in response to these arguments? We could try and mount a defence of extension, motion and so on as primary properties, but unfortunately, about these properties modern science seems to be on Berkeley's side. None of the primary properties of matter listed by Locke and other corpsucularians are now regarded as true properties of the ultimate constituents of matter. Even mass is now regarded as a secondary property produced by the 'rest mass' of things in a certain frame of reference. The only candidates for primary properties that physical science now ascribes to things, such as charge, isospin, spin, 'colour-charge', and so on, lack any counterparts in our experience, so we can hardly say the sensations they produce in us resemble them. However, we can argue that these are properties of things that they possess independently of our perception, and to that extent rescue the idea of primary properties. If we give up on the idea that the primary qualities of things include extension, shape, motion and so on, and instead accept whatever properties contemporary science includes, then we can defend the intelligibility of the idea that physical objects such as electrons and atoms exist mind-independently against arguments (b) and (c). In response to argument (a) we can argue that the properties revealed by modern science are objective, because they can be measured precisely in a way which is repeatable and independent of who is doing the experiment.

For Berkeley, all the supposed primary properties of matter, including extension, are secondary; in other words, all properties only exist when perceived. (For Aristotle all properties are primary.) Berkeley's positive view was a version of idealism. Idealism is the metaphysical thesis that all that exists is mental or spiritual in nature, hence it is incompatible with any form of metaphysical realism, whether direct or causal. Berkeley took his attack on the idea of matter and on the idea of primary properties to show that nothing other than minds can exist unperceived. He argued that so-called external, mind-independent objects are, in fact, mind-dependent, as follows:

(a) We perceive such things as trees and stones.

(b) We perceive only ideas and aggregates (or collections) of them (Ideaism).
(c) Ideas and aggregates of them cannot exist unperceived.
(d) Therefore, trees and stones are ideas and impressions or aggregates of them, and cannot exist unperceived (Idealism).

This argument is clearly valid. If we only perceive collections of ideas, and we perceive everyday objects, then everyday objects must be collections of ideas. If we want to deny (d) and maintain some form of metaphysical realism, we must deny one of the premises. (c) seems to be right. When I am thinking about a horse, surely my idea of it does not exist independently of my mind. As we have seen, Locke accepts ideaism, (b), but gives up on (a) above, and adopts causal realism. Berkeley thinks that his idealism is more faithful to common sense than Locke's causal realism because Locke denies (a). Berkeley calls this the 'royal road to scepticism', because he thinks that once (a) is abandoned there is no way to be sure that we have any knowledge of objects at all.

Empiricists such as Locke adopt ideaism to secure the infallibility of the 'empirical basis' for knowledge in the face of sceptical arguments that seem to undermine it. However, once we look at things this way it is natural to ask how we know that there are *any* external objects causing our ideas of them. This is the problem of scepticism about the external world that was originally made vivid by Descartes. He imagined there was an evil demon feeding sensory impressions to him that created the illusion of a world of objects and people other than himself, when it fact there were none. These days we are more likely to motivate this very strong form of scepticism using the image of a brain in a vat, with its sensory nerves being stimulated by a mad scientist or a computer program. The question in each case is how can we know that this is not our actual situation? If you can't rule out the possibility that you are a brain in a vat, then how can you know any of the things you take yourself to know about the world around you? If we adopt ideaism it seems that we are stuck behind the 'veil of ideas' and in what Ayer called the 'egocentric predicament'. Like Descartes, philosophers such as Berkeley, Hume, Russell and Carnap have all attempted to start with sense-data and recover the everyday world.

The obvious problem for Berkeley's view is to explain how it is that there is such coherence in our ideas, in other words, why we all more or less agree so much of the time about the properties of things in the world around us, and why objects reappear where they were before when we re-enter an empty room. Berkeley's answer to this depends upon his belief in God. He argues that God perceives everything all the time and hence ensures the continued existence of the world around us when we are not observing it. This is unacceptable to the atheist of course, and anyway seems ad hoc. However, although we may reject Berkeley's conclusions, we must appreciate the strength of his arguments and the difficulties they raise for realism.

The subtler idealism of Kant is a more palatable strategy aimed at avoiding scepticism. Whereas Berkeley collapses the external world onto our impressions to solve the problem of how we get from knowledge of the latter to knowledge of the former, Kant agrees with metaphysical realists that there is a mind-independent world, but he agrees with sceptics that we can't have knowledge of it. Instead, he argues, all our knowledge is of the world as it is *for us*. The world in itself he calls the *noumenal* world, and the world as we experience it he calls the *phenomenal* world. Much of our knowledge is of particular facts about the phenomenal world learned through the senses, but Kant thought that some of our knowledge is *a priori*. Although we can only know the measurements of a specific triangle through our senses, we can know that any triangle we experience will have internal angles summing to 180°, by the use of reason alone. According to Kant, arithmetic, geometry and Newtonian mechanics are *a priori* forms of knowledge, not about the noumenal world, but about the form our experience must take. Unfortunately, as I mentioned in Chapter 2, this unravelled in the face of scientific developments. The new physics of the late nineteenth and early twentieth centuries – in particular, relativity theory and quantum mechanics – seems to refute some of the principles of classical science and mathematics.

5.3 Semantics

The philosophy that seems appropriate for the scientific age is empiricism. Our knowledge of the world does indeed seem to be

based not on *a priori* reflection, but on centuries of empirical investigation. However, empiricism is beset by a fundamental problem, namely, if all our contact with the world is mediated by our 'ideas', then how can we know that our experience is a reliable guide to the world as it is in itself. This problem was clearly appreciated by Hume who argued that, although we have no choice but to continue to act as if there is an external world, we have no rational grounds for believing it. Most philosophers have been at least as dissatisfied with Hume's capitulation to scepticism about the external world as with his capitulation to scepticism about induction. We have seen how Berkeley dealt with the problem by denying that there is anything to objects beyond our ideas. According to his view, tables and trees are collections of impressions which have no existence independent of perception. Naturally, such a challenge to common sense is usually met with incredulity by scientifically minded philosophers.

Commonsense metaphysical realism (about the existence of the world around us) is not contentious. Many contemporary western philosophers would say that we are justified in believing in the existence of mind-independent objects, because they are the best explanation of the regularities in our experience. Scientific realists argue that these are just the grounds we have for believing in the existence of the unobservable entities postulated by our best modern scientific theories. Antirealists about scientific knowledge are usually empiricists who oppose the way realists think science can go beyond experience and get at the real causes of things. As we shall see, logical positivism was, in part, an attempt in the hands of some philosophers to put an end to debates about metaphysical realism, antirealism and idealism.

5.3.1 Logical positivism

The term 'positivism' was coined by a French philosopher called Auguste Comte (1798–1857) who argued that societies pass through three stages – namely the theological, the metaphysical and the scientific. In the theological stage, people explain phenomena such as thunder, drought and disease by invoking the actions of gods, spirits and magic. In the metaphysical stage, they resort to unobservable forces, particles and so on. The scientific stage is achieved when

pretensions to explain why things happen, or to know the nature of things in themselves, are renounced; the proper goal of science is simply the prediction of phenomena. He aimed to complete the transition of European thought to the scientific stage by advancing the scientific study of society and social relations (sociology), and established a system of rituals celebrating scientists and science, to replace the traditional calendar of Saint's Days and religious festivals.

Positivism has its roots in empiricism, especially in Hume's attempt to separate the meaningful from meaningless (see Chapter 2, section 2.1). In general, positivists:

(a) emphasise verification/falsification;
(b) regard observation/experience as the only source of knowledge (empiricism);
(c) are anti-causation;
(d) are anti-theoretical entities;
(e) downplay explanation;
(f) are, in general, anti-metaphysics.

There is something positivist in spirit about the mechanists of the scientific revolution with their desire to create a science rooted in experiment, which could avoid the mysterious 'essences' and 'virtues' of Aristotelian natural philosophy. Of course, they were also anti-positivist in so far as they posited theoretical entities such as atoms and forces, and invoked them as causes in their explanations. Hume was a positivist in that he was sceptical about: any relation of causation beyond our association of ideas (see 2.1); substance (or matter beyond phenomena); and the soul (or any idea of the self beyond a fleeting flux of ideas and impressions). Later, the physicist Ernst Mach (1838–1916) argued that physical science should only concern itself with what was observable, and that the function of laws in science is simply to systematise the relations between our experiences.

In the nineteenth century, metaphysics thrived. Idealism and romanticism were prevalent in philosophy, and such mysterious notions as 'the absolute', 'becoming', and 'the will' were widely discussed. By the beginning of the twentieth century, a reaction against this kind of philosophy was developing, and many philosophers and others embraced science, mathematics and logic as the antidote to what they saw as the confused thinking of metaphysicians. Logical

positivism was originally centred around a group of scientists, mathematicians and philosophers called the Vienna Circle, which met in the 1920s. Many of the Vienna Circle were Jewish and/or socialists. The rise of fascism in Nazi Germany led to their dispersal to America and elsewhere, where the ideas and personalities of logical positivism had a great influence on the development of both science and philosophy.

The difference between logical positivism and logical empiricism is a matter of scholarly dispute. The most influential of those classified as logical positivists or empiricists include Moritz Schlick (1882–1936), Carl Hempel (1905–1997), Carnap, Reichenbach (although he was in Berlin, not Vienna), and Ayer (he visited the Circle and brought some of its ideas to Britain). They all adopted the empiricism of Hume and Mach and Comte's aspiration for a fully scientific intellectual culture. What was new about them was that they exploited the mathematical logic, recently developed by Gottlob Frege (1848–1925) and Russell among others, to provide a framework within which theories could be precisely formulated. The idea was that if the connections between ideas and associated experiences could be made precise, then it would be possible to separate meaningless metaphysical mumbo-jumbo from empirical science.

Most of the words we use are for things that are manifest to the unaided senses. As children we learn the names for objects, properties and processes that appear in the world around us by hearing adults use those names and copying them. Of course, language acquisition is amazing because children seem to be so good at it, and because they master grammar and syntax with the minimum of examples. In principle, however, we can understand how they learn the meanings of words like cat, house, red, square, cooking and running. We can even imagine how they go on to build up a full vocabulary from these simple beginnings, because, once someone has enough language, the meanings of new words can be explained to them in terms of words they already know. I may have never seen a woolly mammoth but I know it is a big, hairy elephant, and so on. Hence, it is natural to think that all words get their meanings by their connection to what we can experience, even though sometimes the connection may be remote (concept empiricism).

On this view, the content of each of our thoughts must somehow be

tied to ideas the mind acquires through sensory experience of the world. This implies that no matter of fact that can be intelligibly or meaningfully thought about can go beyond all possible experience. Russell and Ludwig Wittgenstein (1889–1951) are supposed to have had an argument about whether it is meaningful to posit the existence of a hippopotamus that cannot be detected by any scent, sight, sound or touch. If we add to the senses the use of all scientific detection equipment such as radar, infrared cameras and sonar, and the creature is still supposed to be undetectable, then surely it is meaningless to talk about it. Hence, we arrive at what has been called the 'empiricist criterion of meaning', which takes various forms, but is roughly the idea that, to be meaningful, a word must have some connection with what can be experienced.

The logical positivists used this criterion of meaning to criticise theories that they thought were pseudo-scientific, such as psychoanalysis and the theory of vitalism (which posited vital forces responsible for the life of cells and other organisms) because they employed theoretical terms and concepts that could not be explicitly related to what can be observed. They also criticised metaphysics for being meaningless, hence Carnap said:

> The metaphysician tells us that empirical truth-conditions [for metaphysical terms such as 'the absolute'] cannot be specified; if he asserts that nonetheless he 'means' something, we show that this is merely an allusion to associated words and feelings, which however, do not bestow a meaning.
>
> (Carnap 1959: 65)

Similarly, many positivists argued that theological hypotheses were meaningless. For example, since the hypothesis that God is perfectly good or omnipotent does not imply anything about what we experience with our senses, it is, strictly speaking, meaningless. A selection of what they called 'psuedo-concepts' includes 'essence', 'thing in itself', 'the Good' and 'the absolute'. They are psuedo-concepts because statements containing them assert nothing. On the other hand, take the term 'radio wave'. Positivists argue that what makes this term different to a term like 'the absolute' is that its use has implications for what we can observe. So for example, the sentence 'there are radio waves passing through this room' implies that I will

get a response from a radio receiver by tuning it to the appropriate wavelength.

In Chapter 2, I explained Hume's distinction between relations of ideas and matters of fact. Recall that statements that concern only the relations among ideas are those that are true or false just because of the meanings of words. For example, 'if Jimmy is taller than James, and James is taller than Dawn, then Jimmy is taller than Dawn' is true because of what 'taller than' means. On the other hand, 'Jimmy is taller than James' concerns a matter of fact, because it is true or false depending on the heights of the actual people referred to by the names 'James' and 'Jimmy'. The logical positivists employed Kant's similar distinction between analytic and synthetic statements. Analytic statements include: 'what will be will be', 'trees are plants', and 'red is a colour'. Examples of synthetic statements include: 'Paris is the capital city of France', 'the poles of the Earth are covered with ice', and 'the table is brown'.

Logical positivists had the following basic commitments:

(1) Science is the only intellectually respectable form of inquiry.
(2) All truths are either: (a) analytic, *a priori* and necessary, in other words, tautological, or (b) synthetic, *a posteriori* and contingent.
(3) So far as knowledge goes, it is either purely formal and analytic, such as mathematics and logic, or it is a kind of empirical science.
(4) The purpose of philosophy is to explicate the structure or logic of science. Philosophy is really the epistemology of science and analysing concepts.
(5) Logic is to be used to express precisely the relationships between concepts.
(6) The *verifiability criterion of meaning*: a statement is literally meaningful if and only if it is either analytic or empirically verifiable.
(7) *The Verification Principle*: the meaning of a non-tautological statement is its method of verification; that is, the way in which it can be shown to be true by experience.

The positivists tried to find certain foundations for our knowledge of the world. Consider these criteria for foundational truths:

- They must not be inferred from any other beliefs, but rather be self-evident or self-justifying.
- They must be immune from scepticism.
- They must be useful and informative, in other words synthetic, not analytic.

The idea of **foundationalism** is that the justification of beliefs is of two kinds: some (basic) beliefs are justified independently of any other beliefs, whereas non-basic beliefs are justified because basic beliefs either deductively or inductively entail them. Many empiricists take our knowledge of our sensory states to be foundational. For example, my belief that it seems to me as if the light is on is self-justified. The logical positivists tried to use 'protocol statements' as the foundation of knowledge. These are statements that refer only to the immediate content of some experience or observation, such as 'I see a red light flash'. Protocol statements are also called sense-data reports, or basic propositions (Ayer). They are supposed to be *first person singular, present tense, introspection reports*. That is, reports of how things seem to an observer at a given time. As such they are supposed to be: synthetic and contingent, since the observer's experience could be different; immune from doubt, because anyone is supposed to be able faithfully to report at least how things *seem* to them; and not inferred from other beliefs, because the observer simply reports the experience. Hence, they are supposed to meet the above criteria for foundational truths.

The logical positivists argued that all meaningful empirical statements are either *protocol statements* or *empirical hypotheses*. Empirical hypotheses relate protocol statements to each other, and hence allow for prediction. Scientific laws are empirical hypotheses, and they are tested by the predictions they make about what will be observed. Protocol statements are *strongly verified* because their truth is established conclusively by experience. The problem of induction means that any number of experiences consistent with the predictions of a particular law or generalisation, such as all metals expand when heated, do not make it certain that the next observation will follow the same pattern. So protocol statements at best only *weakly verify* empirical hypotheses in the sense that they make them probable rather than certain.

Suppose that we have certain knowledge of the contents of our immediate sensations, and suppose also that empirical hypotheses predicting relations between phenomena are confirmed by observations. This much is consistent with scepticism about the mind-independent world, or with Berkeley's idealism. Recall from 2.2 above that the problem is: granting that we can know about regularities in our experience, how can we know there are objects and people in the world causing them. In other words, even if we can know empirical hypotheses, as well as analytic truths and protocol statements, how can we build knowledge up from these? In other words, how can collections of private sense-data conceivably make up a common world?

We seem to be faced with a dilemma:

(a) We know lots of things about cabbages and kings.
(b) We only know protocol statements and analytic truths.

Scepticism denies (a) – the logical positivists wanted to infer (a) from (b). However, because protocol statements are only certain because they do not refer to anything beyond immediate experience, we cannot use a deductive argument to get from protocol statements to a statement about mind-independent objects, since the conclusion must be somehow implicit in the premises for deductive arguments to be valid. On the other hand, we cannot use an inductive argument to infer (a) from (b), since to do so we would need to observe the coincidence of sensations with the existence of objects, which requires independent access to such objects.

The positivists adopted a lateral thinking solution; they reduced all knowledge to knowledge of protocol statements and necessary truths. They argued that talk of perceived or possible objects is *reducible* to talk of actual or possible experiences. Propositions asserting the existence of physical objects are equivalent to ones asserting that observers will have certain sequences of sensations in certain circumstances. Physical objects are logical constructions out of actual and possible sense-experiences. A physical object is 'a permanent possibility of sensation' and nothing more. This view is sometimes called **phenomenalism**: the logical positivists agreed with those who think philosophers debating the existence of the table is ridiculous; talk of the external world is literally meaningless.

So it seems foundationalism and the radical empiricist doctrine of ideaism together suggest that, if we want to avoid metaphysics, phenomenalism is the only way out of scepticism. So much for Eddington's everyday table; it is a mere construct out of sense-data. But what about the scientific table and all its atoms, electrons, forces and so on? The basic positive goals of logical positivism were as follows:

(I) To show that the use of theoretical terms in science is consistent with the empiricist criterion of meaning.
(II) To show how statements about observations can confirm theoretical statements, in other words to explicate the 'logic of confirmation'.
(III) To show that mathematics and logic are analytic.

We will return to confirmation in later chapters. Although the history of the attempt to achieve (III), and the philosophical issues it raised, are among the most important parts of twentieth century philosophy, they will not concern us further (see further reading below). In the next section we will be concerned with (I).

5.3.2 Semantic instrumentalism and reductive empiricism

For positivists, all empirical knowledge aims at the successful anticipation of future experience. Nineteenth century positivists such as Comte and Mach thought that the postulation of unobservable atoms and fields had no place in science. The problem the logical positivists faced was that the science they admired so much seemed to make indispensable use of empirical hypotheses and laws involving theoretical terms such as 'atom', 'charge', 'nuclear force' and so on. If concept empiricism is right, then how can such terms be meaningful? The logical positivists had two approaches to what they considered to be empirically dubious; they either denied that it was meaningful, as with metaphysics, ethics, theology and so on, or they showed how the meaning could be empirically sanitised to eliminate metaphysics, as with our knowledge of the external world. In order to explain why people talk about supposedly meaningless things so much, Ayer argued that saying 'murder is wrong' merely expresses the speaker's

attitude to murder, rather than stating anything that could be true or false. This is sometimes known as the 'boo–hurrah' theory of ethics, according to which all statements about ethics are merely expressions of an emotional reaction with no other content. Philosophers use the term '*assertoric*' to mean 'genuinely asserts something about the world'. Only assertoric statements are capable of being true or false; for example, the statement 'welcome' is not assertoric, but it does express an attitude. For a statement to be assertoric it does not have to be true; when I say Bristol is bigger than London, I genuinely assert something, but it is false.

Similarly, some antirealists about science deny that statements involving theoretical terms are assertoric. Just as we can use the concept of the average tax-payer to simplify thinking about economics, without thinking that anyone who is the average tax-payer exists, so we can talk about electrons and so on without taking it all literally as really referring to something. This is called **semantic instrumentalism**.

> **Semantic instrumentalism**: the theoretical terms of scientific theories should not be taken literally as referring to unobservable entities, because they are merely logical constructs used as tools for systematising relations between phenomena. Theoretical hypotheses are not assertoric.

On the other hand, others argue that statements involving theoretical terms are assertoric, but that what they say is reducible to statements about observables. The conjunction of (6) and (7) of 5.3.1 above implies that if the theoretical terms of modern science are really meaningful, it ought to be possible to define each of them using only words that refer to sensory experiences and everyday observable objects.

> **Reductive empiricism**: theoretical terms can be defined in terms of observational concepts, hence statements involving them are assertoric. Scientific theories should not be taken literally as referring to unobservable objects.

Here we have an explicit definition of a theoretical term:

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

The problem is most scientific terms cannot be defined this way. Take the term 'temperature'. We need to give an *operational definition* for each possible temperature, since we are not allowed to think of there being one real property with different possible values. An operational definition of 'the temperature is 100° Celsius' is that it is applicable when water is observed to boil at normal atmospheric pressure; but it is also true that a properly calibrated mercury thermometer will read 100, and so too will an alcohol thermometer. The good thing about using a single property of 100° Celsius is that it systematises relations between different experiences. However, according to the operationalist understanding of theoretical terms, every time we encounter a new way of associating the attribution of a temperature of 100° Celsius to something, with something concrete in our experience, we are really introducing a new property. This makes it nonsense to talk about theories being extended to deal with new phenomena. Yet the history of science is full of cases where a theory that was introduced to account for one domain enjoyed empirical success in another one. For example, Maxwell's theory of the electromagnetic field was introduced to account for electricity and magnetism, but it unexpectedly predicted the existence of electromagnetic waves, and thereby accounted in part for the behaviour of light, and also X-rays, infrared, microwaves and so on. (Carnap saw this problem and gave up on seeking an explicit definition of theoretical terms. However, he still wanted to anchor them to experience by giving them a partial interpretation in terms of so-called correspondence rules (see Psillos 1999: chapters 1–3).)

The positivists soon realised that once we describe our experiences in a way that uses a public language then sense-data reports are not incontrovertible, because we have to apply terms correctly and mistakes are possible. In the case of the real observational language of science, say 'the reading on the ammeter was 4 amps', it is obvious that observation reports are fallible. That is why scientists repeat tests that other people have done to guard against error. The logical positivists and empiricists reacted to this problem by giving up on certain foundations of knowledge and abandoning the verification principle ((7) of 5.3.1 above). They emphasised instead empirical *confirmation* or *falsification*, in other words, something counting for or against the proposition (empirical decidability). Some of them embraced realism

of some kind. An important part of scientific realism is a commitment to taking the language of science, even the parts of it that seem to refer to unobservable entities, literally, rather than trying to reduce or eliminate theoretical terms in favour of observational terms.

5.3.3 Truth

Some forms of antirealism are based, not on the elimination of theoretical terms, but on theories of truth that deny the realist conception of truth as correspondence between language and the world. Hence, some antirealists argue that theoretical statements of science are to be taken literally and are assertoric, but that what makes them true or false is not an objective reality beyond all experience. A social constructivist (see 4.6), for example, need not deny that theoretical terms 'refer' nor that theories are true, but may insist that truth is *internal* to our norms and practices, and that the entities to which we refer are socially constructed. For example, it is perfectly true to say that checkmate is the end of a game of chess, or that England borders Scotland, but these facts are constituted by our conventions. Some philosophers think many or all facts are like that, and apply this to other domains rather than just to science. Hence, a social constructivist about mathematics will argue that there are no truths in mathematics beyond those that are provable by mathematicians.

Hence, we can distinguish various theories of truth, the first being:

> *The correspondence theory of truth*: a statement is true when it corresponds to the facts. The terms in the statement refer to things and properties in the world. The conditions under which statements are true or false (truth-conditions) are objective, and determine the truth or falsity of those statements depending on how things stand in the world.

Most advocates of the correspondence theory regard it as necessary to make explicit a commitment to mind-independent truth conditions. Those who adopt the verification principle ((7) of 5.3.1) believe the idea of truth beyond what can be verified makes no sense. Others argue for a *pragmatic* theory of truth, which is one according to which what is true is something like 'what works best in the long

run'. Others that, because we can never escape our language and tell whether it successfully 'hooks onto the world', what is true is what fits best with everything else we believe; this is a *coherence* theory of truth.

5.4 Standard scientific realism

If we incorporate both metaphysical and semantic realism about some subject matter S (which could be ethics, mathematics, aesthetics or theoretical science, among others) and add an *epistemic* requirement we get a strong form of realism about S:

(i) the entities or kinds of entities talked about and/or described by discourse about S exist;
(ii) their existence is independent of our knowledge and minds.

These are the metaphysical requirements.

(iii) Statements about S are irreducible/ineliminable and are genuinely *assertoric* expressions;
(iv) truth conditions for statements of S are objective and determine the truth or falsity of those statements depending on how things stand in the world.

These semantic requirements are cashed out in terms of a correspondence theory of truth, as opposed to a pragmatic or a coherence theory of truth.

(v) Truths about S are knowable and we do in fact know some of them, and hence the terms of S successfully refer to things in the world.

This is the epistemic requirement.

If we take S to be science we get the classic statement of scientific realism, due in its first modern incarnation to Hilary Putnam (1926–), Wilfrid Sellars (1912–1989) and others.

For example, if we are considering electron theory then scientific realism says that:

(i) electrons exist;

(ii) mind-independently;
(iii) statements about electrons are really about subatomic entities with negative charge, spin 1/2, a certain mass, and so on;
(iv) these statements are true or false depending on how the world is;
(v) we should believe electron theory and much of it counts as knowledge.

5.5 Antirealism

We have seen that scientific realism involves three kinds of philosophical commitment: a metaphysical commitment to the existence of a mind-independent world of observable and unobservable objects; a semantic commitment to the literal interpretation of scientific theories and a correspondence theory of truth; and finally an epistemological commitment to the claim that we can know that our best current theories are approximately true, and that they successfully refer to (most of) the unobservable entities they postulate, which do indeed exist. To be an antirealist about science it is only necessary to reject one of these commitments, and antirealists may have very different motives, so there are a variety of antirealist positions that we ought now to be able to distinguish: sceptics deny (i), reductive empiricists deny (iii), social constructivists such as Kuhn (on some readings) deny (ii), while, as we shall see in the next chapter, constructive empiricists such as Bas van Fraassen deny only (v), but also do not believe or remain agnostic about (i).

Alice: So now you're saying that science might give us knowledge up to a point but it only tells us about what we can observe?

Thomas: Maybe so. It seems possible.

Alice: Yes, well, it's possible that the table we are sitting at is a figment of our imaginations or that it disappears when nobody is looking at it but so what? You can't prove anything beyond doubt but that doesn't mean we don't know anything. If all you are saying is that I have as much right

to believe atoms are real as I do to believe the table is real then I agree with you.

Thomas: Slow down. There's a difference. When you claim to know there's a table there, you aren't claiming to know about ultimate reality or the hidden nature of things, just about how things seem.

Alice: Well, I am claiming that the table exists even when I am not looking at it and that it is the same table you see, and that it will still be here if we go away for a minute and then come back and . . .

Thomas: Yes, but at least sometimes we can observe the table. The point about atoms and the like is that they are purely theoretical. For all we know there could be quite different things causing what we see.

Alice: You might as well say that it just looks as if I am sitting here but I'm not really.

Thomas: I don't think it's the same thing, and anyway, as far as science is concerned, all that matters when it comes down to it is getting the predictions right for what we observe. Lots of different theories that disagree about what the unobservable world is like could still agree in what they predict about the results of experiments.

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Realism, ideaism and idealism

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